

# Survival After Pancreatoduodenectomy

## 118 Consecutive Resections Without an Operative Mortality

MICHAEL TREDE, B.A., B. CHIR, M.D., HON. F.R.C.S.(ENG), GUNTHER SCHWALL, M.D.,  
and HANS-DETLEV SAEGER, M.D.

Twenty-one years ago, Howard published a paper entitled "Forty-one Consecutive Whipple Resections Without an Operative Mortality." That paper stimulated the present analysis of the last 118 consecutive pancreatoduodenectomies (107 Whipple and 11 total resections) performed at the Surgical University Clinic Mannheim from November 1985 to the present day with no deaths. Ninety-one resections were performed for neoplasms and 27 were for complicated chronic pancreatitis. The preoperative evaluation, operative technique, and postoperative care of these cases is discussed in detail and compared to the experience of Howard. While there was general agreement on operative technique, there were differences concerning preoperative evaluation (modern imaging methods) and postoperative care (simplification). In this series 21 postoperative complications required seven relaparotomies. Long-term survival after resection for carcinoma was analyzed for 133 consecutive patients who were shown to have true ductal adenocarcinoma. In 76 patients, who had radical ( $R_0$ -) resections, the actuarial 5-year-survival rate was 36%. In 44 patients, whose  $R_0$ -resections for pancreatic cancer occurred more than 5 years ago, the actual survival rate was 25%.

**T**WENTY-ONE YEARS AGO, a classic paper,<sup>1</sup> 'Pancreatico-Duodenectomy: Forty-one Consecutive Whipple Resections Without an Operative Mortality' by John M. Howard, M.D., was published in the *Annals of Surgery*.

The present paper is conceived as a tribute to that remarkable achievement—remarkable because it was performed at a time when this operation was all but abandoned as a high-risk, low-yield procedure.

In reviewing Howard's paper again, it seemed worthwhile to analyze our own more recent experience with pancreatoduodenectomy at the Mannheim Surgical Clinic, applying the same guidelines used by Howard 21 years ago. This comparison, even though viewed in the light of recent progress, revealed more similarities than

*From the Department of Surgery, Klinikum Mannheim, Heidelberg University, Mannheim, West Germany*

expected and only a few divergencies. In addition our experience seems worth reporting because even today there are doubts about the advisability and feasibility of this operation.<sup>2,3</sup>

### Clinical Material

From November 1985 to the present day (August 15, 1989) 118 consecutive pancreatoduodenectomies were performed without an operative mortality at the Mannheim Surgical Clinic. There were 70 men and 48 women. The age of these patients ranged from 24 to 78 years, with a mean of 57 years.

The indications for pancreatoduodenectomy and the types of operation performed are summarized in Table 1.

The resection rate for adenocarcinoma of the head of the pancreas was 22%; for other periampullary tumors it was 75%. For complicated chronic pancreatitis only 48%

TABLE 1. Indications for 118 Pancreatoduodenal Resections

| Diagnosis                         | Whipple | Total Pancreatoduodenal Resections |
|-----------------------------------|---------|------------------------------------|
| Adenocarcinoma of pancreas        | 46      | 7                                  |
| CA of papilla                     | 15      | 1                                  |
| CA of dist. common duct           | 11      | —                                  |
| CA and leiomyosarcoma of duodenum | 6       | —                                  |
| Malignant apudoma                 | 3       | 2                                  |
| Complicated chronic pancreatitis  | 26      | 1                                  |
| Total                             | 107     | 11                                 |

Address reprint requests to Prof. Dr. Michael Trede, Chirurgische Universitätsklinik, Klinikum Mannheim, D-6800 Mannheim 1, West Germany.

Accepted for publication October 10, 1989.

TABLE 2. *Preoperative Evaluation Before Pancreatectomy*

|   |
|---|
| History and clinical examination                  |
| Abdominal ultrasound (pancreas, bile duct, liver) |
| CAT scan  |
| ERCP ( $\pm$ biopsy and stenting)                 |
| Angiography                                       |
| Fine-needle cytology                              |
| Hypotonic duodenography                           |
| Laboratory tests (endocrine + exocrine function)  |

of patients referred for surgical treatment were, in fact, operated on and only 15% had a Whipple resection.

Ten previous upper abdominal operations had been performed, mainly in other hospitals, including four cases with recent exploration or attempted resection, which compounded the technical difficulties.

Operative mortality is defined here as any death occurring during the operation or thereafter until the patient had recovered and was discharged from the hospital. None of these 118 patients died within 2 months of the resection; the earliest subsequent death occurred 6 weeks after hospital discharge.

### Preoperative Evaluation and Management

Table 2 lists the preoperative investigations in order of importance and sequence of performance.

A searching history and clinical assessment of the patients's physical and mental states heads the list. Thus persistent gnawing backache in a patient with pancreatic carcinoma might weigh as heavily against resection as would hopeless and unrepentant alcoholism in chronic pancreatitis.

Abdominal ultrasound, the 'surgeon's stethoscope,' comes next and usually identifies the pancreatic mass, dilated bile ducts with or without stones, and possible hepatic metastases.

Endoscopic ultrasound is used increasingly to localize enlarged lymph nodes, but it cannot distinguish between inflammatory enlargement or metastatic occupation as yet.<sup>4</sup>

A computed tomographic scan is added because it provides clear and reproducible pictures (independent of the investigator's skill); in essence, however, it only duplicates the ultrasound findings.

Although normal in many patients with overt pancreatic disease, endoscopic retrograde cholangiopancreatography (ERCP) often provides surprising and decisive results. The 'double-duct sign' is as diagnostic of a periampullary tumor as the discrete but constant stenosis of an otherwise normal duct of Wirsung (Fig. 1). In papillary tumors the diagnosis usually can be confirmed by biopsy.

Furthermore this diagnostic tool can be turned into a

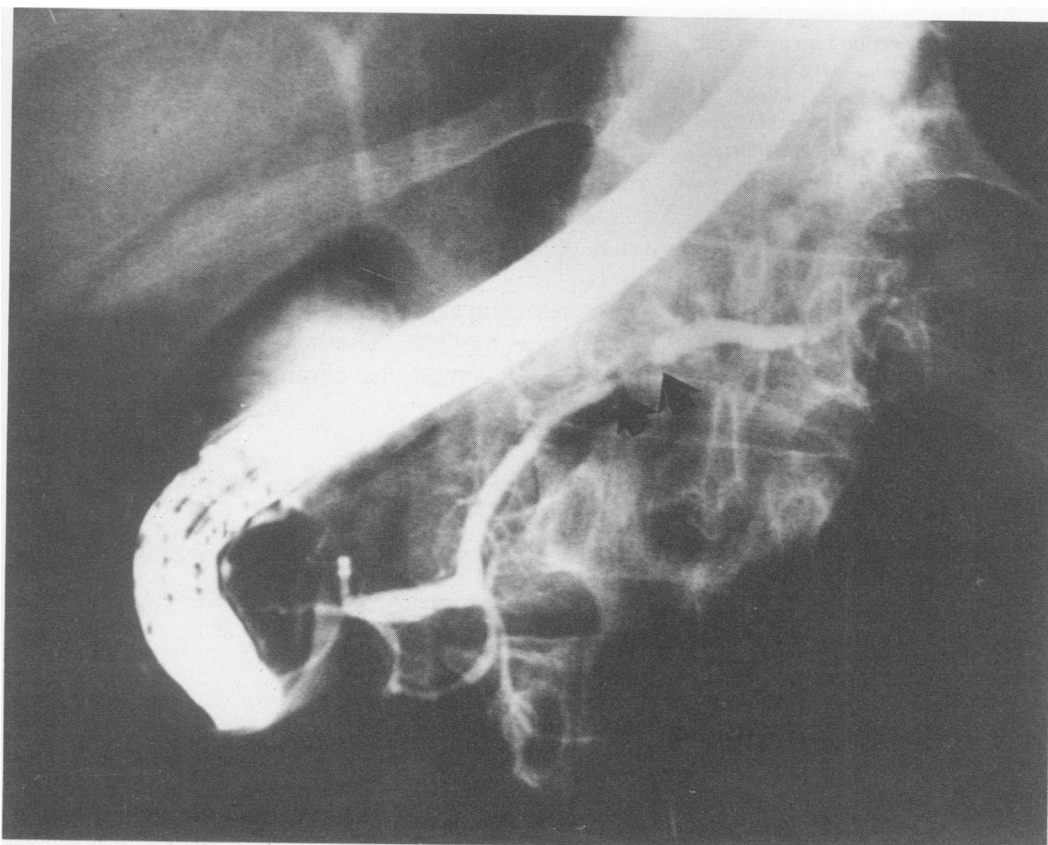
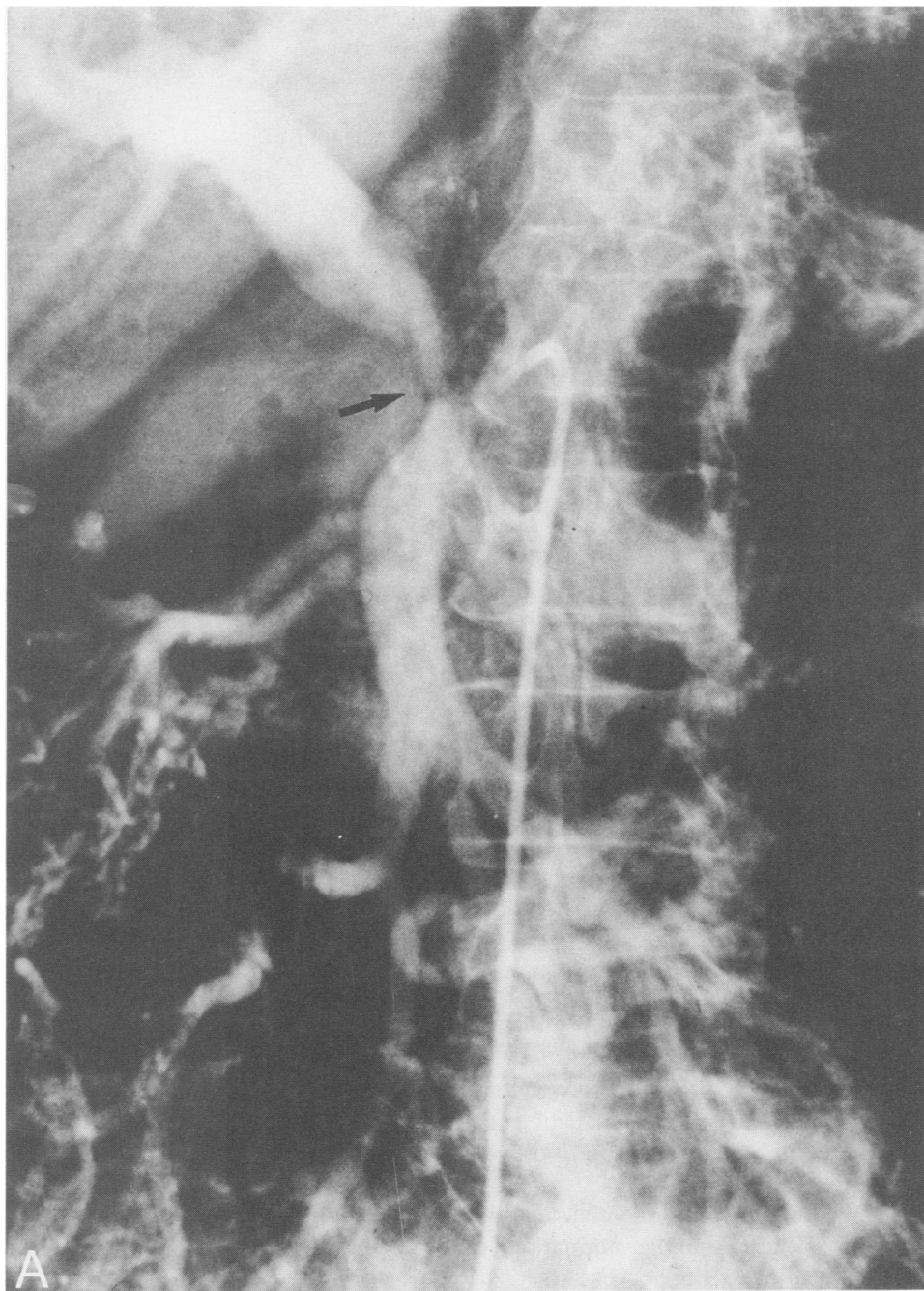


FIG. 1. Patient: male, 55 years old. This ERCP with constant stenosis (arrows) was the sole objective finding (suspicion of carcinoma) in this patient with mild epigastric discomfort. Intraoperative needle biopsy = chronic pancreatitis. Final diagnosis of total pancreatectomy specimen = adenocarcinoma of pancreas (T<sub>2</sub> N<sub>1</sub> M<sub>0</sub>).

FIG. 2A. Patient: female, 72 years old. Carcinoma of the head of the pancreas with obstructive jaundice. Preoperative angiography of superior mesenteric and portal veins shows severe stenosis (arrow) indicative of tumor infiltration and inoperability.



therapeutic weapon in cases of obstructive jaundice. After years of debate and apparent evidence to the contrary,<sup>5,6</sup> we, like others,<sup>7</sup> have settled for endoscopic transpapillary drainage for all these cases (it is successful in 80%) in preparation for the definitive resection.<sup>8</sup>

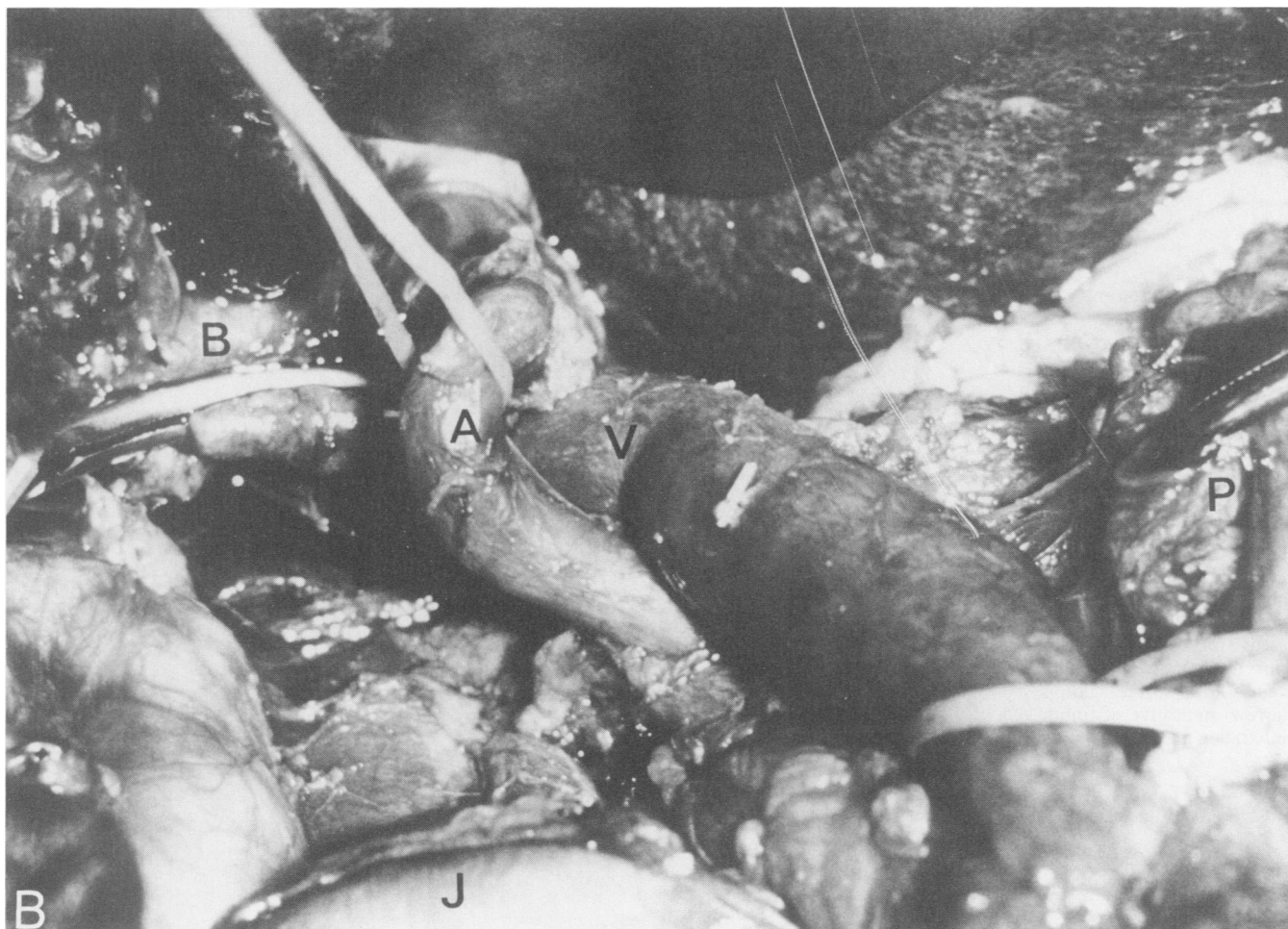
Angiography was once a fixture on our list because it detects congenital vascular anomalies and signs of inoperability. But because it has let us down occasionally on both counts (Fig. 2) and because with increasing experience we rely more on surgical exploration, we no longer insist on this examination. It is useful, however, as a final

confirmation of inoperability in patients believed to be inoperable on other counts.

The same applies to fine-needle cytology.<sup>9</sup> Because only the positive finding of cancer cells is valuable, we do not use it routinely but only for confirmation of diagnosis in inoperable cases.

A barium or gastrografin upper GI series (in particular a hypotonic duodenography) sometimes is used to document obstruction in the periampullary duodenum.

Laboratory tests are mentioned last because they are of little help in surgical decision making in patients with



FIGS. 2B AND C. Operative site and sketch showing that stenosis of portal vein (V) was merely caused by an unusual coiling of the hepatic artery (A); B = dilated common hepatic duct; P = pancreatic remnant; J = stapled proximal end of jejunum.

chronic pancreatitis or cancer. We do, however, study tumor markers as well as pancreatic exocrine and endocrine function before operation to provide a baseline for the postoperative course.

That leaves only three essential steps in the preoperative evaluation—history and examination, ultrasound, and ERCP—before the experienced surgeon can proceed with surgical exploration of the pancreatic patient.

### The Technique of Resection

This is standardized in eight distinct steps.<sup>10</sup>

#### *Incision*

The best approach to the pancreas is provided by a right subcostal incision that is extended over to the left as soon as obvious inoperability has been excluded.

#### *Exploration*

Careful palpation should exclude hepatic or gross lymph node metastases, as well as tumor infiltration of the mesenteric root and hepatoduodenal ligament.

The hepatic flexure of the colon is mobilized, followed by the whole of the duodenum by means of the Kocher maneuver. This will check on mobility of the pancreatic head and also expose the vena cava, left renal vein, and aorta.

The right half of the greater omentum is then detached from the transverse colon, thus opening the lesser sac widely and exposing the pancreas from the front.

Needle biopsy of an obvious and symptomatic mass in the head of the pancreas has been all but abandoned in operable cases. Harbrecht summed it appropriately when he said, 'Even if you like and admire your pathologist, as I do mine, you cannot give him your full trust on pancreatic biopsies.'<sup>11</sup> With this in mind, such a mass should

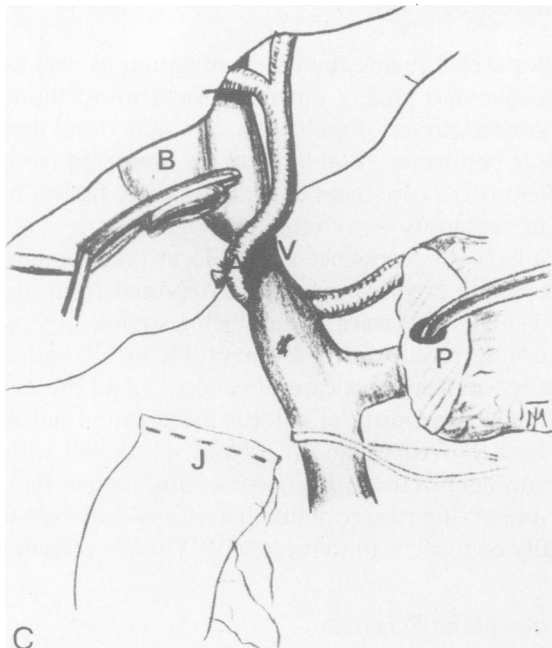


FIG. 2C.

always be resected, even in the absence of histologic proof of malignancy—provided that this can be done with little risk.<sup>12</sup>

Lymph node biopsies are taken in the course of the procedure (along the right margin of the portal vein, the

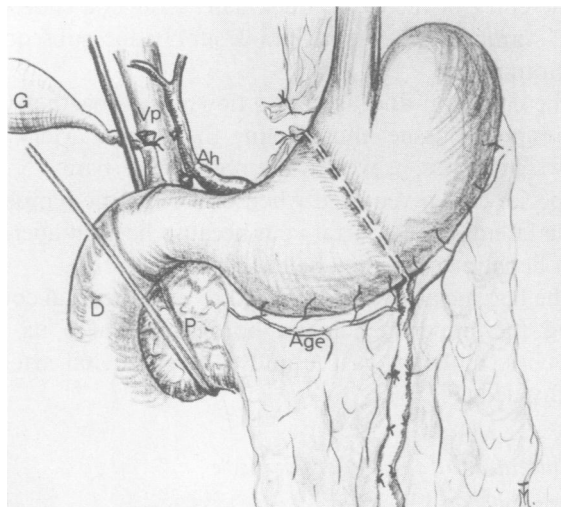


FIG. 4. Sketch showing extent of gastric and omental resection. G = gall bladder; Vp = portal vein; Ah = hepatic artery; D = duodenum; P = pancreas; Age = gastroepiploic artery.

superior borders of the duodenum, and pancreatic neck). But these are usually negative and would not influence resection, if this is feasible.

#### *Cholecystectomy and Dissection of the Hepatoduodenal Ligament*

Resection begins with mobilization of the gallbladder from its bed and division of the hepatic duct just proximal

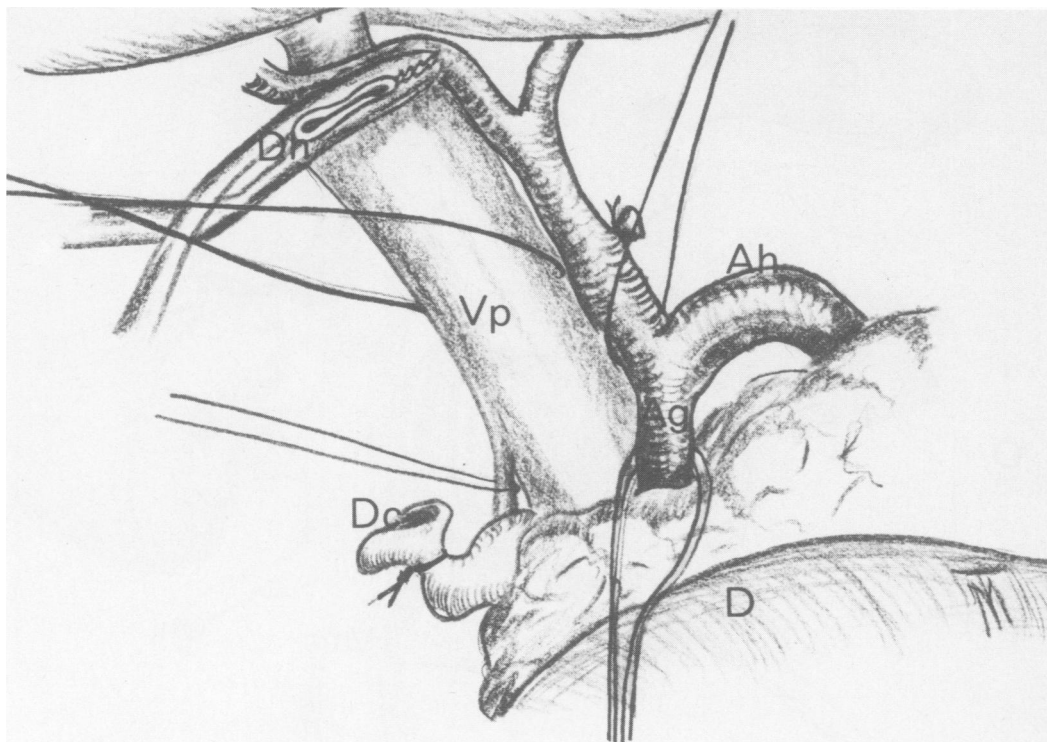


FIG. 3. Sketch of the dissected hepatoduodenal ligament. Dh = hepatic duct; Vp = portal vein; Ah = hepatic artery; Ag = gastrooduodenal artery; Dc = distal common duct; D = duodenum.

to the entry of the cystic duct. This ensures a short bile duct stump with a good blood supply for subsequent anastomosis.<sup>13</sup>

The common duct is peeled downward together with all lymphoid tissue, thus leaving the hepatic artery and its two branches, as well as the portal vein, bare.

Special care is required when dissecting the lymphoid tissue lateral to the portal vein because here an aberrant right hepatic artery may be hidden.

The hepatic artery is mobilized in its horizontal course along the upper pancreatic border and here its two branches, the right gastric and gastroduodenal arteries, are divided (Fig. 3).

#### *Mobilization of the Pancreas Neck*

This delicate step is performed from above, keeping close to the anterior walls of the portal and superior mesenteric veins with a blunt instrument or careful finger. Although all venous tributaries enter the large retropancreatic veins from the right or left side (none from the front), this maneuver may end in severe venous hemorrhage if the passage is narrow (e.g., in chronic pancreatitis) or if there is malignant infiltration of the vein. When this occurs it is best to tamponade this retropancreatic space with gauze and to go on to step 5 because such venous bleeding often stops spontaneously. Any attempt at hemostasis by suturing in this tunnel is futile and dangerous.

#### *Partial Gastrectomy*

After skeletonizing the lesser omentum as well as the gastrocolic and greater omentum right up to the lesser and greater curves of the stomach, a 40% distal gastrectomy is performed. The low rate of postoperative ulcer problems (3%) convinces us that any more radical resection or vagotomy is not required (Fig. 4).

We have no experience with pylorus-preserving resections. While excellent results are reported from experienced surgeons,<sup>14</sup> warnings are being sounded by others concerning postoperative ulcer problems<sup>15,16</sup> and compromised radicality in case of cancer.<sup>17</sup> And the alleged functional superiority of pylorus preservation has in no way been proved so far. At present we are left with the fair comment of the protagonists of this method that 'pyloric-preserving pancreatoduodenectomy is at least functionally equivalent to the standard Whipple resection.'<sup>18</sup>

#### *Division of the Pancreas*

Depending on the site of the tumor the pancreas is now divided, well to the left of the great veins along the tunnel prepared in step 4.

The pancreatic duct is identified and small bleeders are sutured with 3:0 silk. If the tumor reaches anywhere near the line of resection, total pancreatectomy must be performed. Furthermore seldom is it indicated to avoid a

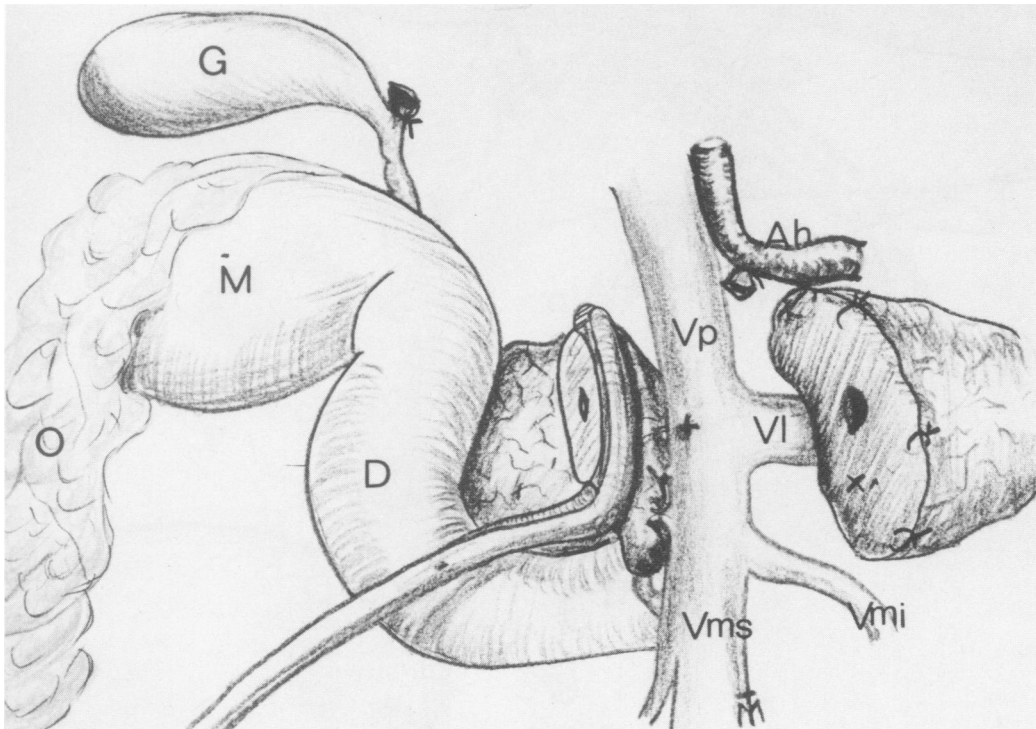


FIG. 5. Sketch of operative site after division of pancreas. G = gall bladder; M = stomach; O = greater omentum; D = duodenum; Ah = hepatic artery; Vp = portal vein; VI = splenic vein; Vms = superior mesenteric vein; Vmi = inferior mesenteric vein.

hazardous anastomosis with a very friable pancreatic remnant.

Total pancreatectomy involves detachment of the greater omentum from the transverse colon right up to the splenic flexure, mobilization of the spleen together with the pancreatic tail from left to right, division of the short gastric vessels between stomach and spleen, and blunt dissection of the lower pancreatic border from the base of the mesocolon. Division of the splenic artery and vein, close to their origins, completes this step.

#### *Dissection of the Retropancreatic Vessels*

Whether the pancreatoduodenectomy is to be partial or total, the whole specimen (including gallbladder, stomach, and greater omentum) is retracted *en bloc* to the right, thus placing mild tension on the plane between the pancreas and mesenteric root behind it (Fig. 5).

One by one the delicate retropancreatic veins and the posterior pancreatoduodenal arteries are divided, leaving the superior mesenteric vessels skeletonized.

Sometimes it is only at this stage that malignant infiltration of the portal vein from the posterolateral side is discovered. The surgeon now has two alternatives: dissect the tumor from the vein, inevitably leaving some of it behind (*i.e.*, this R<sub>2</sub> resection will be palliative only), or resect the involved segment of vein *en bloc* with the tumor.

However, with one exception, this regional pancreatotomy type I also yielded only palliative results. After isolating and clamping the superior mesenteric, splenic, and portal veins, tangential resection with suture (9 cases) or segmental resection either with end-to-end anastomosis (1 case) or graft interposition (2 cases) is performed. To avoid excessive intestinal venous congestion during this resection, it is helpful to clamp the inflow, *i.e.*, the superior mesenteric artery as well (Fig. 6).

#### *Division of the Jejunum*

After mobilization of the distal duodenum, the ligament of Treitz is divided and the first two or three inches of the jejunum are skeletonized. Finally the jejunum is divided and the complete specimen is removed *en bloc* (Fig. 7).

### **The Technique of Reconstruction**

Operative repair is performed in three steps; the end result is illustrated in Figure 8.

#### *Pancreatojejunostomy*

The upper end of the jejunum is brought up behind the mesenteric root to lie tension-free against the cut surface of the pancreatic remnant for a two-layered end-to-end telescope type of anastomosis.

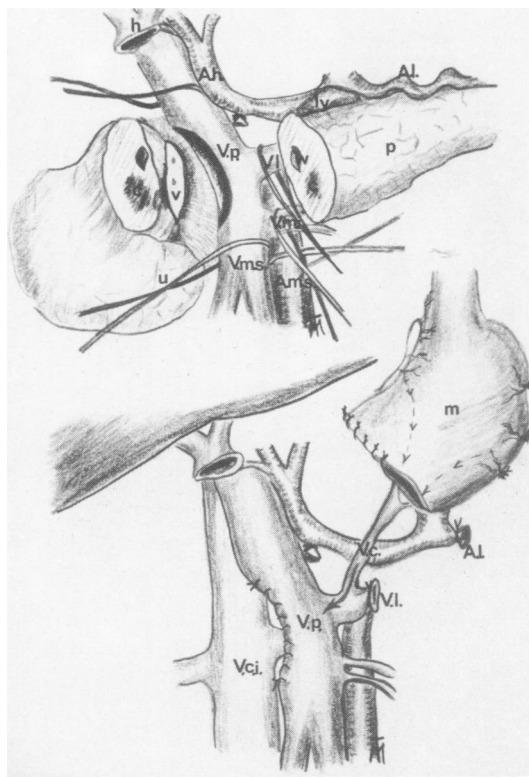


FIG. 6. Patient: female, 63 years old. Operative sketch showing infiltration of portal vein (V.p.) by cancer (c), necessitating tangential resection of a segment of vein (v) along with total pancreatectomy (above). Below: operative site before biliodigestive reconstruction. h = common hepatic duct; Ah = hepatic artery; ly = lymph node along neck of pancreas; Al = splenic artery; p = pancreas; u = uncinate process; Vms = superior mesenteric vein; Vmi = inferior mesenteric vein; Ams = superior mesenteric artery; m = stomach; V.c.i. = inferior vena cava.

We use 3:0 chromic catgut for the inner layer without attempting to place mucosa-to-mucosa sutures in the pancreatic duct, unless this is extremely dilated. Also we have never used any form of pancreatic duct drainage or occlusion. 3:0 silk is used for the outer invaginating layer of sutures.

#### *Hepaticojejunostomy*

The second anastomosis is placed as far down-stream from the first anastomosis as possible. But if kinking of the jejunal loop is to be avoided, the distance will seldom exceed 12 cm. This anastomosis consists of just one layer of 4:0 resorbable sutures. It is routinely splinted by a Völker-type silastic drain, which facilitates the suturing of a narrow bile duct and, we hope, helps to decompress the proximal jejunum, thus keeping bile away from the pancreatic anastomosis, as pointed out by Howard<sup>1</sup> (Fig. 9).

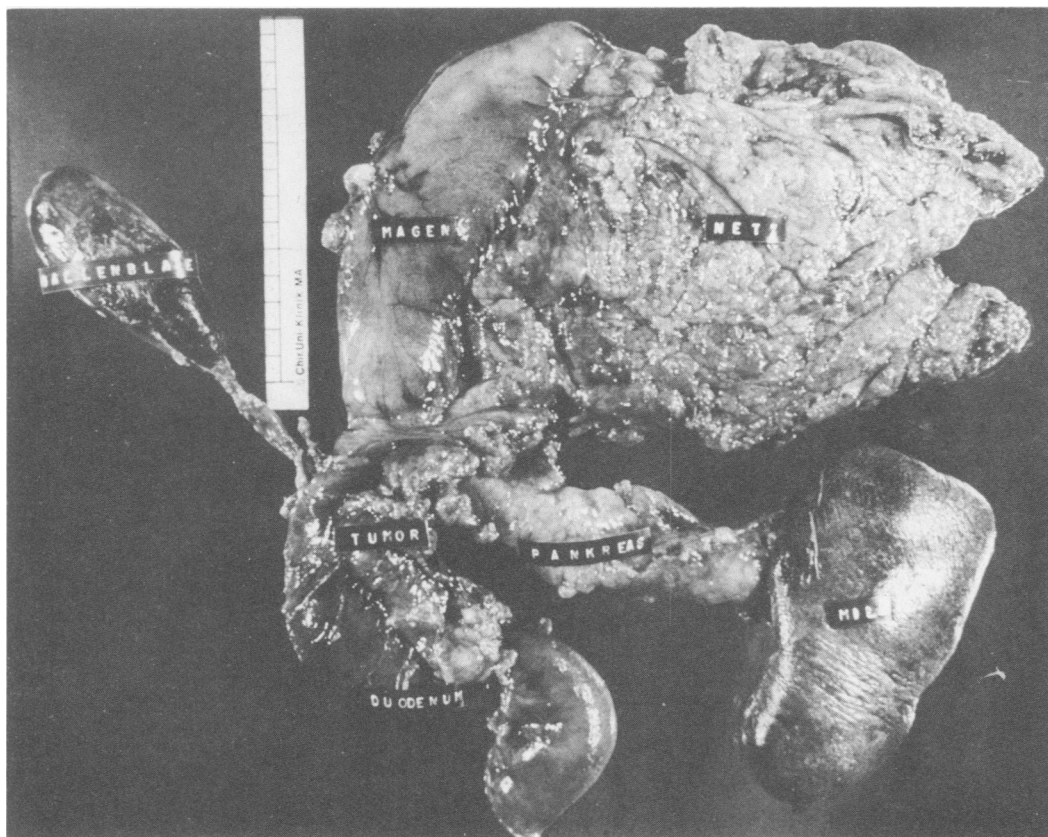


FIG. 7. Patient: male, 57 years old. *En bloc* specimen of total pancreatectomy for a T<sub>2</sub> N<sub>0</sub> M<sub>x</sub> adenocarcinoma of the pancreatic head. Long-term survival: 7 years, so far.

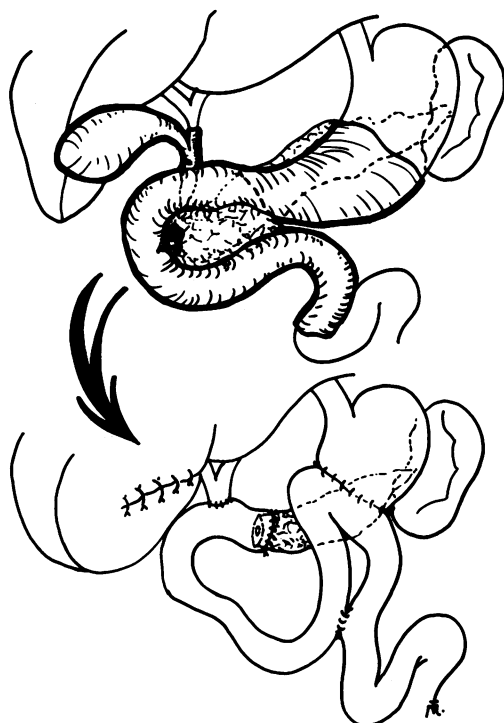


FIG. 8. Sketch showing extent of *en bloc* Whipple resection (above) and technic of reconstruction (below).

Furthermore this drain can be used for the postoperative radiologic control of both suture lines if a leak is suspected. However, because this retrograde instillation of gastrografin has sometimes been followed by a spike in fever (ascending cholangitis?), we have abandoned these routine x-ray controls. The Völker-drain is removed 3 weeks later.

#### Gastrojejunostomy

This final anastomosis is placed a full 50 cm further downstream in form of an antecolic partial gastrojejunostomy (two layers with 2:0 silk outside and 2:0 chromic catgut inside).

A final Braun jejunojunctionostomy serves to ensure decompression of the proximal jejunal loop.

A single soft silastic drain is placed behind the proximal two anastomoses and is usually withdrawn on the 5th postoperative day.

Some further perioperative data are on record: these operations were performed by 10 different surgeons (under supervision of the senior author); the operating times varied from 4.5 to 9 hours (median, 5.75 hours); the blood loss was between 200 mL and 6000 mL (median, 900 mL).

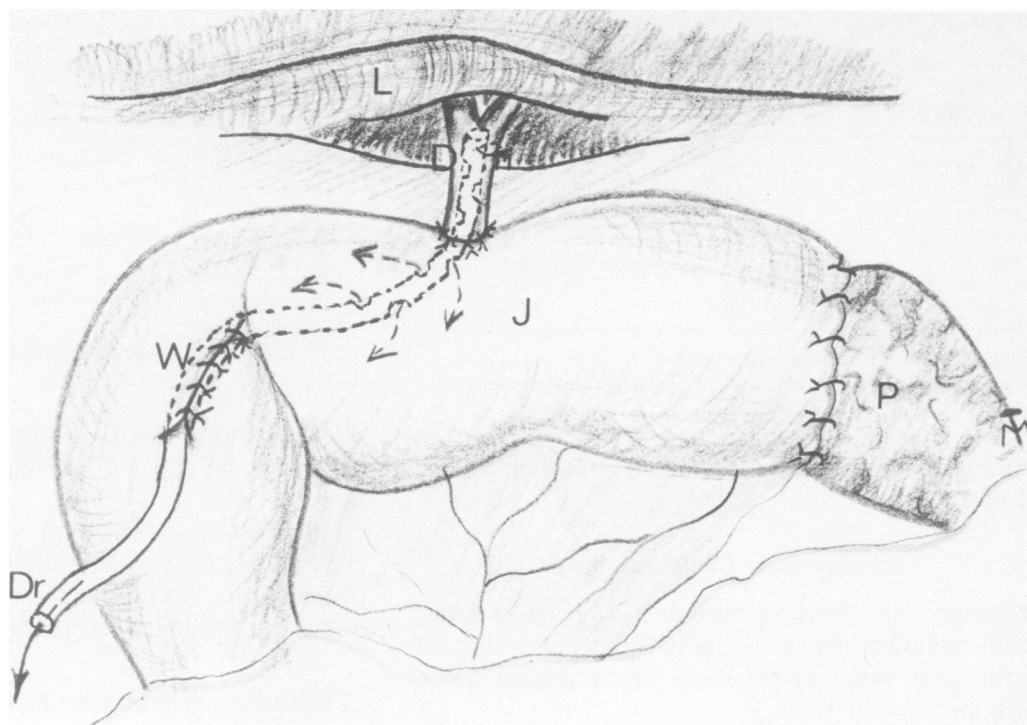


FIG. 9. Sketch illustrating the hepatojejunal anastomosis splinted by a Völker drain (Dr) brought out through the jejunal wall (J) by a Witzel-type canal (W); L = liver; D = common hepatic duct; P = pancreas.

### Postoperative Care

Postoperative care is kept as simple as possible, with emphasis placed on the close-meshed clinical observation of the patient on the surgical intensive care unit.

Our anesthesiologists pride themselves in extubating these patients on the operating table.

We remove the gastric tube on the morning after operation; peroral fluids (sips of tea) are allowed as soon as peristalsis begins (48 to 72 hours after operation) and thereafter intravenous fluids are reduced step-wise and discontinued completely on the 5th day after operation.

Postoperative medication is confined to prophylactic antibiotics (cefazolin  $3 \times 2$  g) on the day of operation only; stress ulcer prophylaxis with Ranitidine ( $3 \times 50$  mg intravenously for 5 days); prophylaxis of bronchopul-

monary complications with acetylcystein ( $3 \times 300$  mg intravenously for 5 days); and thrombosis prophylaxis with heparin sodium ( $3 \times 5000$  international units, subcutaneously for 10 days).

TABLE 4. Recent Early Results of Pancreatoduodenectomy

| Authors                                | No. of Patients<br>n | Operative Mortality |     |
|--|----------------------|---------------------|-----|
|  |                      | n                   | %   |
| Van Heerden <sup>20</sup> *            | 146                  | 6                   | 4.1 |
| Jones, Langer <sup>21</sup>            | 87                   | 4                   | 4.6 |
| Siedeck <sup>22</sup>                  | 112                  | 2                   | 1.8 |
| Braasch <sup>14</sup> †                | 87                   | 2                   | 2.3 |
| Grace, Longmire <sup>23</sup> §        | 45                   | 1                   | 2.2 |
| Tsuchiya <sup>24</sup> ‡               | 94                   | 4                   | 4.2 |
| Crist, Cameron <sup>25</sup> §         | 47                   | 1                   | 2.1 |
| Gall <sup>26</sup> ¶                   | 289                  | 3                   | 1   |
| Cooper, Carter, et al. <sup>27</sup> ¶ | 83                   | 4                   | 4.3 |
| Bittner, Beger <sup>28</sup>           | 60                   | 3                   | 5   |
| Lygidakis, van der Hyde <sup>29</sup>  | 78                   | 3                   | 3.8 |
| Pellegrini, Way <sup>30</sup> §        | 51                   | 1                   | 2   |

This list lays no claim to completeness.

The series are not comparable.

\* 10 resections for benign lesions.

† Pylorus-preserving pancreatotomy for malignant and benign lesions.

‡ Pancreatotomy for small carcinomas (<2 cm) only.

§ Inclusive pylorus-preserving pancreatotomy for malignant and benign lesions.

¶ Pancreatotomy for chronic pancreatitis only.

¶ Total pancreatotomy for chronic pancreatitis only.

TABLE 3. Complications of 118 Pancreatoduodenectomies

| Complication     | n  | Relaparotomy |
|------------------|----|--------------|
| Pancreatic leak  | 9  | 1            |
| Hemorrhage       |    |              |
| Gastrointestinal | 4  | 1            |
| Operating field  | 2  | 2            |
| Biliary fistula  | 3  | —            |
| Abscess          | 2  | 2            |
| Jejunal torsion  | 1  | 1            |
| Total            | 21 | 7            |

TABLE 5. *Long-term Survival After Pancreatoduodenectomy for Adenocarcinoma of the Pancreas*

| Author                      | No. of Patients Resected | 5-year Survival Rate (%) |
|-----------------------------|--------------------------|--------------------------|
| Cooperman <sup>31</sup>     | 70                       | 7.1                      |
| Van Heerden <sup>32</sup>   | 44                       | 2.3                      |
| Lerut <sup>33</sup>         | 25                       | 6.0                      |
| Jones, Langer <sup>21</sup> | 28                       | 7.0                      |
| Grace <sup>23</sup>         | 37                       | 3.0                      |
| Connolly <sup>34</sup>      | 89                       | 3.4                      |
| Crist <sup>25</sup>         | 50                       | 18.0                     |

This list lays no claim to completeness.

The results (most of them actuarial survival rates) are not comparable.

Postoperative hospitalization ranged from 10 to 44 days (median, 16 days).

### Postoperative Complications

Keeping to the above regimen, the postoperative course usually resembles that after a partial gastrectomy. But, of course, there were complications in the present series, which are listed in Table 3.

The management of these complications has been discussed before in detail.<sup>19</sup> It is worth mentioning that for this recent series of 107 Whipple procedures, complications at the pancreatic anastomosis occurred in only 8% and only one required a further operative intervention. In fact the overall rate of relaparotomy is only 6%.

### Discussion

When comparing this series with that of Howard's 21 years ago, it is indeed remarkable how much agreement there is, particularly regarding the details of operative technique. The main divergencies concern preoperative evaluation and postoperative care.

Progress in modern imaging procedures is such that bothersome intraoperative cholangiograms and pancreatograms are now obsolete. On the other hand, this progress has not, so far, improved the timely detection of early cancer of the pancreas.

As for postoperative care, we believe that patients benefit by simplification. Tracheostomy and assisted respi-

TABLE 7. *Late Results of Pancreatectomy for Pancreatic, Papillary, and Periampullary Carcinoma*

| No. of Patients Operated on Before August 1984 | No. of 5-Year Survivors as of August 1989 |
|--|---|
| Head of pancreas                               | 44 11 (25%) (-4)*                         |
| Papilla  | 36 21 (55%) (-5)*                         |
| Choledochus and duodenum                       | 17 4 (23%) (-3)*                          |
| Total  | 97 36 (36%) (-12)*                        |

R<sub>0</sub>-resections only.

\* Died more than 5 years after operation.

ration for one or two days, used by Howard in more than one half of his patients, was required by none of our patients.

Adjuvant cancer chemotherapy (applied empirically and half-heartedly by Howard) has not been given to our patients—nor has intra- or postoperative radiation. This brings us to one final section of this paper.

### Long-term Survival After Pancreatectomy for Cancer

While Howard's results were indeed remarkable 21 years ago, today good results are being reported from many centers all over the world (Table 4).

But has the lowered operative mortality rate of pancreatectomy resulted in improved long-term survival in pancreatic cancer patients? With few exceptions,<sup>25</sup> these results have been disappointing (Table 5).

To answer this question for our own clinical material, we must look beyond those 53 pancreatectomies performed for adenocarcinoma of the pancreas since 1985.

The total experience of the Mannheim Surgical Clinic goes back to October 1972. Since then 370 consecutive pancreatoduodenectomies have been performed (57 total and 313 Whipple procedures). Nine patients died, yielding an overall operative and hospital mortality rate of 2.4% (Table 6).

In 133 patients pancreatoduodenectomy was performed for true ductal adenocarcinoma of the pancreas; 3 patients died in the hospital, thus accounting for a mortality rate of 2.2%. Because the remaining 130 patients were seen

TABLE 6. *Early Results of Pancreatoduodenectomy*

| Type of Procedure    | No. of Patients | Diagnosis |              | Operative and Hospital Mortality |
|----------------------|-----------------|-----------|--------------|----------------------------------|
|                      |                 | Neoplasm  | Pancreatitis |                                  |
| Whipple operation    | 313             | 209       | 104          | 6                                |
| Total pancreatectomy | 57              | 40        | 17           | 3                                |
| Total                | 370             | 249 (7%)  | 121 (2%)     | 9 (2.4%)                         |

From the Surg. Univ. Clinic Mannheim, October 1, 1972 to August 15, 1989.

**Survival Rate after  
Pancreatectomy for Adeno-Ca of Pancreas  
(n=130)**

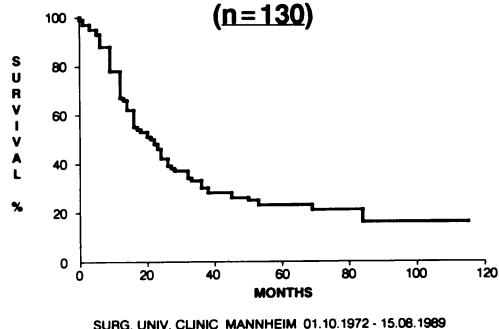


FIG. 10. Actuarial survival plotted according to Kaplan-Meier for all 130 patients, who survived pancreatic resection for carcinoma.

after operation at regular 6-month intervals with a 98% complete follow-up, we can look at survival from three angles. Figure 10 shows the actuarial survival curve plotted according to Kaplan-Meier for all 130 patients who survived pancreatectomy for cancer. Here the statistical probability of surviving 5 years amounts to 24%.

By dividing this group of 130 resections further, according to standard criteria of radicality, we reach a more realistic analysis (Fig. 11) and discover that 54 patients really had no fair chance of long-term survival. In these patients the tumor appeared macroscopically resectable but in the end the operation was not radical ( $R_2$ -resection) for one of three reasons: (1) tumor tissue had to be dissected off large vessels, thus leaving insufficient tumor-free margins; (2) in a few cases small remnants of tumor were knowingly left behind; and (3) the pathologist reported microscopic tumor infiltration along the lines of resection. As was expected, none of these 54 patients survived more than 2 years, although nearly all of them had good palliation for a time.

**Survival Rate after  
Pancreatectomy for Adeno-Ca of Pancreas  
(n=130)**

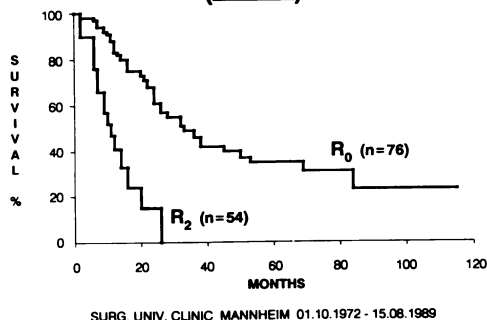


FIG. 11. Actuarial survival plotted according to Kaplan-Meier for 76 patients with  $R_0$  resections and 54 patients with  $R_2$  resections for pancreatic cancer.

**Pancreatic Cancer  
Survival after Pancreatectomy  
(n=76  $R_0$ -Resections only)**

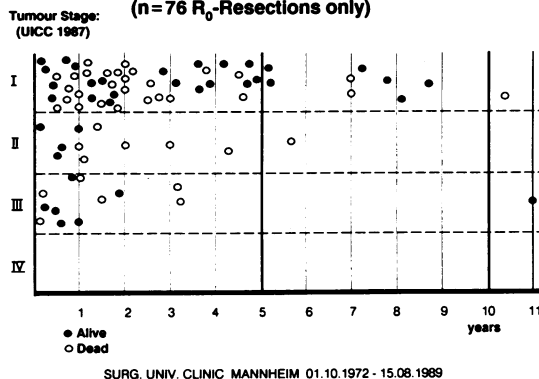


FIG. 12. Survival of 76 patients who had  $R_0$  resections for pancreatic adenocarcinoma plotted against the stage of the disease.

But the 76 patients in whom a radical resection of adenocarcinoma of the pancreas was possible (both macroscopically and microscopically)—so-called  $R_0$ -resection—did far better. The 5-year survival rate for this group was 36%.

A second view on long-term results is provided by Figure 12, in which survival is plotted against the stage of the disease (Union International Cotre Cancer classification, 1987) of those 76 patients who had  $R_0$ -resections.

It is evident that all but two long-term survivors belong to stage I ( $T_1N_0M_0$ ). But it is worth noting that three patients survived more than 3 years, in spite of lymph node metastases (stage III =  $T_{1-3}, N_1M_0$ ). And one of the latter is still alive 11 years after total pancreatectomy including portal vein resection for a  $T_3N_1$  ductal carcinoma of the pancreas (reviewed and reviewed again by independent pathologists).

Finally, without any statistical manipulation, one can look at the fate of those 44 patients, whose  $R_0$ -pancreatectomy for adenocarcinoma (partial or total) was performed more than 5 years ago. Table 7 shows that 33 patients have since died. But 11 reached the 5-year survival limit, which is 25% of those resected.

These long-term survival results are, of course, open to criticism on several counts: (1) The figures—36% actuarial survival among 76 consecutive  $R_0$ -resections, and 25% actual survival among 44  $R_0$ -resections—may not be large enough to carry full statistical significance. (2) 5-year survival after resection for pancreatic cancer does not mean that patients are cured in every case. A glance at Figures 11 and 12, as well as Table 7, clearly shows that four more patients have so far died after passing the 'magic line' and they died of late recurrent and metastatic pancreatic cancer. (3) The sceptical reader will rightly ask if all of these 133 patients did indeed have ductal adenocarcinoma of the pancreas.

Fully aware of the notorious difficulties that experienced pathologists can have in distinguishing some cases of pancreatic adenocarcinoma from papillary or endocrine carcinoma or even chronic pancreatitis,<sup>11</sup> we had all the specimens and slides reviewed. And all long-term survivors were reviewed again by an independent pathologist, as suggested by van Heerden.<sup>36</sup>

Nine of an initial 142 patients with a primary diagnosis of 'adenocarcinoma of the pancreas' did not pass this rigorous test (ampullary carcinoma, 5; colloid carcinoma, islet-cell carcinoma and cystadenocarcinoma, 1 each). This left the 133 patients, whose long-term fate was the basis for this final section.

In conclusion, the improved early results of pancreatoduodenectomy seem to justify recommending this operation to every operable patient.<sup>37</sup> Even if the chances of cure are slim, this operation provides the best possible palliation. For long-term survival, the results for surgery alone reported here do not justify complacency. It remains to be seen, however, if they will stand the test of time, turn out to be reproducible, or if they can be improved by the addition of adjuvant oncologic modalities of treatment.

### Note Added in Proof

As of January 1, 1990, the number of consecutive pancreatoduodenectomies performed with mortality has reached 142.

### Acknowledgments

The authors wish to thank Dr. M. Bohrer (Institute of Pathology, Klinikum Mannheim) for reviewing, and Prof. Dr. V. Becker (Institute of Pathology, University of Erlangen) for reviewing again the histologic specimens referred to in this paper.

### References

- Howard JM. Pancreatico-Duodenectomy: forty-one consecutive Whipple resections without an operative mortality. *Ann Surg* 1968; 168:629-640.
- Bernard HR. Discussion of Connolly MM. *Ann Surg* 1987; 206:366-371.
- Lea MS, Stahlgren LH. Is resection appropriate for adenocarcinoma of the pancreas? A cost-benefit analysis. *Am J Surg* 1987; 154:651-654.
- Dancygier H, Classen M. Endoskopische Sonographie im oberen Verdauungstrakt: Möglichkeiten und Grenzen. *Dt Arztebl* 1987; 84:1880-1885.
- McPherson GAD, Benjamin IS, Habib NA, et al. Percutaneous transhepatic drainage in obstructive jaundice: advantages and problems. *Br J Surg* 1982; 69:261-264.
- Pitt HA, Gomes AS, Lois JF, et al. Does preoperative percutaneous biliary drainage reduce operative risk or increase hospital cost? *Ann Surg* 1985; 201:545-553.
- Lygidakis NJ, van der Heyde MN, Lubbers MJ. Evaluation of preoperative biliary drainage in the surgical management of pancreatic head carcinoma. *Acta Chir Scand* 1987; 153:665-668.
- Manegold BC, Jung M. Endoskopisch-therapeutische Eingriffe an den Gallen- und Pankreaswegen. *Chirurg* 1987; 58:392-401.
- Parsons L Jr, Palmer CH. How accurate is fine-needle biopsy in malignant neoplasia of the pancreas? *Arch Surg* 1989; 124:681-683.
- Trede M. Technik der Duodenopancreatektomie nach Whipple. *Chir Praxis* 1985; 34:611-633.
- Harbrecht PJ. Discussion of Wilson SM. *Arch Surg* 1974; 108:539.
- Moossa AR, Lewis MH, Mackie CR. Surgical treatment of pancreatic cancer. *Mayo Clin Proc* 1979; 54:468-474.
- Terblanche J. Oral personal communication, August 28, 1986.
- Braasch JW, Deziel DJ, Rossi RL, et al. Pyloric and gastric preserving pancreatic resection. Experience with 87 patients. *Ann Surg* 1986; 204:411-418.
- Gebhardt C, Gall FP, Rösch W, Schackert HK. Anastomosenuklus nach Whipplescher Operation mit Magenerhaltung. *Zbl Chirurgie* 1982; 107:952-958.
- McAfee MK, van Heerden J, Adson MA. Is proximal pancreatoduodenectomy with pyloric preservation superior to total pancreatectomy? *Surgery* 1989; 105:347-351.
- Sharp KW, Ross CB, Halter SA, et al. Pancreatoduodenectomy with pyloric preservation for carcinoma of the pancreas: a cautionary note. *Surgery* 1989; 105:645-653.
- Fink AS, DeSouza LR, Mayer EA, et al. Long-term evaluation of pylorus preservation during pancreatoduodenectomy. *World J Surg* 1988; 12:663-670.
- Trede M, Schwall G. The complications of pancreatectomy. *Ann Surg* 1988; 207:39-47.
- Van Heerden JA. Pancreatic resection for carcinoma of the pancreas: Whipple versus total pancreatectomy—An institutional perspective. *World J Surg* 1984; 8:880-888.
- Jones BA, Langer B, Taylor BR, Girotti M. Periapillary tumors: which ones should be resected? *Am J Surg* 1985; 149:46-52.
- Siedek M, Birtel F, Mitrenga I. Pankreasganganastomose und Pankreatojejunoplicatio nach Rechtsresektion. *Langenbecks Arch Chir* 1985; 366:610.
- Grace PA, Pitt HA, Tompkins RK, et al. Decreased morbidity and mortality after pancreatoduodenectomy. *Am J Surg* 1986; 151:141-149.
- Tsuchiya R, Noda T, Harada N, et al. Collective review of small carcinomas of the pancreas. *Ann Surg* 1986; 203:77-81.
- Crist DW, Sitzmann JV, Cameron JL. Improved hospital morbidity, mortality, and survival after the Whipple procedure. *Ann Surg* 1987; 206:358-373.
- Gall FP. Chronische Pankreatitis: chirurgische Therapie durch Resektionsverfahren. *Langenbecks Arch Chir* 1987; 372:363-368.
- Cooper MJ, Williamson RCN, Benjamin IS, et al. Total pancreatectomy for chronic pancreatitis. *Br J Surg* 1987; 74:912-915.
- Bittner R, Roscher R, Safi F, et al. Der Einfluss von Tumorgroße und Lymphknotenstatus auf die Prognose des Pankreaskarzinoms. *Chirurg* 1989; 60:240-245.
- Lygidakis NJ, van der Hyde MN, Houthoff HJ, et al. Resectional surgical procedures for carcinoma of the head of the pancreas. *Surg Gynecol Obstet* 1989; 168:157-165.
- Pellegrini CA, Heck CF, Raper S, Way LW. An analysis of the reduced morbidity and mortality rates after pancreaticoduodenectomy. *Arch Surg* 1989; 124:778-781.
- Cooperman AM, Herter FP, Marboe CA, et al. Pancreatoduodenal resection and total pancreatectomy—an institutional review. *Surgery* 1981; 90:707-712.
- Van Heerden J, ReMine W, Weiland L, et al. Total pancreatectomy for ductal adenocarcinoma of the pancreas. *Am J Surg* 1981; 142:308-311.
- Lerut JP, Gianello PR, Otte JB, Kestens PJ. Pancreatoduodenal resection. Surgical experience and evaluation of risk factors in 103 patients. *Ann Surg* 1984; 199:432-437.
- Connolly MM, Dawson PJ, Michelassi F, et al. Survival in 1001 patients with carcinoma of the pancreas. *Ann Surg* 1987; 206:366-371.
- Van Heerden J. Discussion of Connolly MM. *Ann Surg* 1987; 206:366-371.
- Warshaw AL, Swanson RS. Pancreatic cancer in 1988. Possibilities and probabilities. *Ann Surg* 1988; 208:541-553.